SCIENCE:

A WEEKLY RECORD OF SCIENTIFIC PROGRESS.

JOHN MICHELS, Editor.

PUBLISHED AT

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P. O. Box 3838.

SATURDAY, AUGUST 7, 1880.

To Correspondents.

All communications should be addressed to the Editor—Box 3838, P. O., New York—with name and address of writer, not necessarily for publication without consent.

Scientific papers and correspondence intended for publication, should be written *legibly* on one side only of the paper. Articles thus received will be returned when found unsuitable for the Journal.

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To Advertisers.

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ANALYSIS OF WATER.

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As the value of such analysis of the water supply of cities is great, especially at a time when the subject is receiving so much attention, we gladly welcome some valuable work accomplished in this direction at Newark, New Jersey, by Dr. Herman H. C. Herold, of that city, and placed at the disposal of "SCIENCE."

As Dr. Herold has made his calculations both for grains in the imperial gallon, and also according to the metric system, we reproduce both in tabular form. To this record is added the analysis of water from a New York well, also made by Dr. Herold, and described by him at page 13 of this Journal, forming part of No. 2, issued July 10th last.

The inference Dr. Herold draws after making these analyses, is that relatively the water from the Passaic river stands at the head of the list, as being the most favorable as a water supply for Newark, in comparison with that obtained from driven wells.

Still the Aqueduct Water (Passaic) is not in a satisfactory condition, its imperfections being due to impurities derived from the city of Newark itself, and not from Paterson and other towns above it, as the run of twelve miles would oxidize such organic matter.

The results of an analysis of the aqueduct water of Newark City, made by Dr. Herold in the month of June, as compared with the results of the analysis made in March, shows a decided deterioration in the condition of the water during the time between the two periods. To a very great extent this may be explained as being a result of natural causes. During the interval we suffered from a prolonged drought, the lowlands being thoroughly drained and converted into pools, the flood-tide, flowing farther up the river than is usual, carried with it much of the impurities of the city which are emptied into the river. The distance being short, these impurities did not have adequate opportunity for oxygenation and destruction. As will be seen by a comparison of the following tables, the amount of solid residue, 6.688 grains per imperial gallon, is about double that obtained by the former analysis, which showed only 3.147 grains per imperial gallon. The amount of organic matter has increased 2½ times, or 0.957 grains against 0.378 grains of the former analysis. A still more alarming increase is found in the chlorine, 0.636 grains to 0.211 grains, found in the former analysis—an increase of 300 per cent.

Dr. Herold also states that his views regarding the advantages of securing a water supply for cities from running streams is strengthened by further examination of the question and everyday experience. Whatever organic matter may find its way into a running river is necessarily largely diluted. In the constant change of position and great increase of surface it is exposed to the oxygen of the air and also to that in the water; the plants along the bottom and sides of the stream are sure to absorb a certain proportion and by these means, if the water is only given far enough to flow, the matter contained in it cannot but be neutralized and to a very great extent destroyed. The great advantage to cities in being supplied from such a source is now generally conceded by all authorities who have made the subject of hygiene a study.

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Constituents.	1880. Grains in an Imp. Gal. Newark City Aqueduct. March.	Newark City Aqueduct. June.	Public Well, cor. Orange and Broad Streets, Newark. March.	Public Well, cor. Ferry and Congress Streets, Newark. March.	Balbach's Artesian Well, Newark. March.	Newark Driven Well. June.	New York Driven Well. June.
Total solid constituents	3.147	6.688	22.277	36.929	125 833	49.782	31.434
After incineration	2.377	.....	17.673	21.312	92.849	.....	.....
Lime (CaO)	1.357	1.225	7.150	6.842	40.953	6.940	4.396
Sulphate of lime (Cao, SO_3, 2 HO)	None.	.....	6.016	6.016	120.346	6.052	8.665
Carbonate of lime (CaO, CO_2)	2.220	.....	9.270	8.717	3.155	7.940	.....
Bicarbonate of lime (CaO, 2 Co_2)	.....	.....	.....	.....	.....	.....	3.304
Magnesia, (MgO)	Trace.	0.452	Trace.	Trace.	Trace.	2.468	3.162
Chloride of Magnesium (Mg Cl_2)	.....	.....	.....	.....	.....	.....	1.815
Carbonate of Magnesia. (5 MgO, 4 Co_2, 6HO)	.....	.....	.....	.....	.....	5.981	5.824
Chlorim (Cl.)	0.211	0 636	3.392	5.939	0 845	8.486	6.374
Chloride of Sodium (Na Cl)	0.379	.....	5.596	9 794	1 398	13.901	8.215
Soda (Na_2O)	.....	0.318	.....	.....	.....	12.187	4.315
Sulphuric Acid (SO_3)	None.	1.245	2.798	2.798	55.974	9.865	5.096
Sulphate of Sodium (Na_2O, SO_3)	.....	.....	.....	.....	.....	11.188	.....
Iron (Fe O)	Trace.	.....	Trace.	Trace.	Trace.	.....	.....
Silica ($Si O_2$)	Not estimated	1.293	Not estimated.	Not estimated.	Not estimated.	4.701	1.736
Carbonic Acid (Co_3)	.....	0.705	.....	.....	.....	7.199	4.396
Organic and Volatile matter	0.378	0.957	1.395	12.408	None.	7.374	6.446

Constituents.	1880. Grammes in a Litre. Newark City Aqueduct. March.	Newark City Aqueduct. June.	Public Well cor. Orange and Broad sts., Newark. March.	Public Well cor. Ferry and Congress sts., Newark. March.	Balbach's Artesian Well, Newark. March.	Newark Driven Well. June.	New York Driven Well. June.
Total solid constituents	0.0450	0.0956	0.3184	0.5278	1.7884	0.7115	0.4485
After incineration	0.0340	.....	0.2526	0.3046	1.3270	.....	.....
Lime (CaO)	0.0194	0.0176	0.1022	0.9780	0.5853	0 0992	0.0692
Sulphate of lime (CaO, So_3, 2HO)	None.	0.0298	0.0860	0.0860	1.7200	0.0865	0.1236
Carbonate of lime (CaO, CO_2)	0.0346	0.0096	0.1325	0 1246	0.0451	0.1135	.....
Bicarbonate of lime (CaO, $2CO_2$)	.....	.....	.....	.....	.....	.....	0.0471
Magnesia (MgO)	Trace.	0.0064	Trace.	Trace.	Trace.	0.0353	0.0451
Chloride of Magnesium ($MgCl_2$)	.....	0.0050	.....	.....	.....	.....	0.0259
Carbonate of Magnesia 5 MgO, $4CO_2$, 6 HO)	.....	0.0105	.....	.....	.....	0.0855	0.0830
Chlorine (Cl)	0.0030	0.0090	0.0485	0.0849	0.0121	0.1213	0.0909
Chloride of Sodium (NaCl)	0 0050	0.0086	0.0800	0.1400	0.0200	0.1987	0.1172
Soda (Na_2O)	.....	0.0035	.....	.....	.....	0.1742	0.0616
Sulphuric Acid (SO_3)	None.	0.0175	0.0400	0.0400	0.8000	0.1410	0.0727
Sulphate of Sodium (Na_2O, SO_3)	.....	.....	.....	.....	.....	0.1599	.....
Iron (FeO)	Trace.	.....	Trace.	Trace.	Trace.	.....	.....
Silica (SiO_2)	Not estimated.	0.0185	Not estimated.	Not estimated.	Not estimated.	0.0672	0.0248
Carbonic Acid (CO_2)	.....	0.0101	.....	.....	.....	0.1029	0.0627
Organic and Volatile matter	0.0054	0.0136	0.0104	0.1778	None.	0.1054	0.0920

We have been shown a number of photographs copyrighted by Mr. Geo. Cumming, of this city, entitled, 'Studies of the Color Glow, or Rectilinear Spectrum." The original colored line drawings which were exhibited in 1879, at the Academy of Design and American Institute, consist of geometrical forms drawn in straight lines, in many hues of color, forming central globes with bright scintillating effects. While the photographs give but the form on a much reduced scale without, of course, the chief beauty—the blended color-lines--they are curious as illustrating the depth of tone obtained by the camera from any given shade or tint—light green for instance coming out deep black and violet being almost lost in the process. The originator has more of an artistic than a practical feeling in their conception, and calls his various designs *spring*, *sunset*, *autumn*, *sunrise*, etc; his idea being to embody a theory of color with pleasing effect, rather than to stamp himself as either an artist or designer.

We desire to direct special attention to the meeting of the American Society of Microscopists at Detroit, on the 17th of this month, presided over by Professor H. L. Smith, of Hobart College, Geneva, N. Y.

The conception of such a national meeting of microscopists is most excellent, and under such able leadership the results of the meeting cannot fail to promote the extension of microscopical research, and its elevation to the high position it should occupy, as one of the greatest aids to our possession of scientific knowledge, the comprehension of the workings of Nature and "of things around us."

XUM

NEW SOURCES OF FOOD.

BY W. N. LOCKINGTON.

Advance in civilization is marked by an advance in the choice of food. In the words of Spencer, "There is an analogy between progress in bodily nutrition and progress in mental nutrition. The higher types of mind, like the higher types of body, have greater powers of selecting materials fit for assimilation."

As there is room for much further advance in mental nutrition, so is there for much advance in bodily nutrition. The choice of food has hitherto been determined empirically. Prejudice is the usual guide. A few experiments with foods, and finding some hitherto unused or little known article to be exceedingly nutritious, or to supply a want, they recommend its adoption, but either their recommendation is unheeded, or the new article wins its way into favor with exceeding slowness.

The multitudinous forms of animal and vegetable life could furnish us with many an article of food equal or superior to those in use. We have not yet been through the full range of nature in our search for food. Yet our wide-spreading commerce has made us familiar with many foods that were formerly unknown, so that, prejudiced though we are, our range of food is wide compared with that of our ancestors, or that of a savage, but almost all the plants we grow for food purposes, as well as almost all the animals we eat, are, if not those used by our own ancestors, those which have been used for ages by other peoples with whom we have come in contact. It is the same with animals and vegetables used in the arts. We have adopted them from others—few indeed have had their merits discovered and utilized.

The seed of certain grasses and certain leguminous plants have for thousands of years been the chief sources of nutriment procured by man from the vegetable world, and they fulfill his purpose well; but the two immense orders of *Leguminosæ* and *Gramineæ*, the latter entirely, the former chiefly composed of plants that are adapted for food, could furnish many additional species that would not only vary our dietary, but give us a supply or food under conditions that preclude the growth of species now in use. The number of fruits cultivated might be greatly increased. Almost every section of country furnishes some nut or berry which even in its wild state is pleasant to the taste.

What might not cultivation do for some of these. It has given us all the varieties of plum and cherry, apple and pear, from sour and unpromising originals, and the long category of vines from one European species. Many edible roots, stems and leaves have yet to be discovered or improved into value.

A few species of the order *Cruciferæ* are eaten, while the rest are neglected. Yet the whole order is good for food. A botanist could multiply examples throughout the range of vegetable life, but it will suffice here to give one more; the mushroom or fungus tribe, so little known, so much dreaded, yet containing so many edible species. Again and again it has been shown that the same amount of observation which enables a man to distinguish night-shade from the potato, or carrots from hemlock, would enable him to discriminate between the poisonous and edible mushrooms, yet only an enthusiastic band ever dares to venture beyond the conventional species. The species favored by the Anglo-Saxon is in ill-favor with the Italian, who has a wider range of edible fungi, as have also the Frenchman and the Russian.

As mushrooms can be grown in places where ordinary plants will not flourish, an increased taste for and knowledge of them would be of great benefit to our poor. If from the vegetable world we turn to the animal, we find prejudice and ignorance still more rampant. The Mosaic law is still obeyed in this matter by nations who break it in most others.

The ordinance which restricted the Israelites to the use, for food purposes, of such quadrupeds only as chew the cud and divide the hoof, was in the then state of knowledge a wise and safe one.

All such animals are herbivorous, and are better fitted for food than carnivorous mammals. They are of large size, furnish an abundance of healthy muscle, and have in many instances been domesticated for ages. But numerous other large animals are herbivorous also, and extensive series of small animals are graminivorous or frugivorous, devourers of seeds or fruits. Why should not these be eaten? The omnivorous pig, whose diet, at least in a state of domestication, is not particularly choice, and whose flesh is less nutritious and less wholesome than that of most other mammals, is largely eaten by man, yet the prejudice against horse flesh is almost universal among Aryans.

We occasionally eat a hare or rabbit, but the rest of the rodentia, mostly seed or root eaters, are neglected. The ground squirrels, a plague on the Pacific slope of the United States, would cease to be so were man to make a systematic onslaught upon them to gratify his taste. Their flavor is pronounced excellent by all who have tried them. The taste for this or that particular article of food is to a great extent acquired.

Many who ultimately become fond of oysters dislike them at first. The same remark holds true of many other foods in common use. The muscles of all birds and mammals are suitable for food when in a perfectly healthy condition. More care is necessary in the case of carnivorous mammals, since their flesh decays more rapidly; yet it is doubtful whether one person in ten could distinguish cat from rabbit were they cooked alike and the more tell-tale portions removed.

The strong or fishy flavor of marine mammals and birds would doubtless be objebted to by those whose gustatory nerves had learned to relish high game and Limburger cheese, yet as safe sources of nutriment they would at least be superior to the former.

Civilized nations of Aryan descent devour many mammals and birds, some batrachia and many fishes; but the intervening class of reptiles is almost wholly ignored. Why? Simply because of the pious horror of the snake. Lizards, as they have long tails, are viewed only a little less unfavorably, while tortoises—thanks to their widely different form—are accepted with some reservation; yet the flesh of snakes and lizards is as firm, as nutritious and as healthy as that of fishes, if not more so; and those who have eaten them when among peoples who do not share our prejudices, have had their own shaken. The Frenchman, who is a good cook, eats frogs; the Englishman cannot conquer his prejudice.

Leaving the vertebrata; the choice made by civilized nations among the invertebrata is highly eccentric.

A Spaniard or Frenchman relishes a cuttle fish, which an American or Englishman shudders at; and the harmless snail and slug, *per se* as good food as oysters, are esteemed by some nations and detested by others.

There is little doubt that the great majority of mollusks of sufficient size are healthy food, and that man has yet to discover among them many a *bonne bouche*.

Descending lower still, sea-urchins, sea-anemones and sea-cucumbers are eaten by some highly civilized nations, and who can tell how acceptable they might prove to an Anglo-Saxon could he but conquer the horror he feels at their appearance.

P. H. Gosse, so well known for his interesting works on natural history, tells us how he cooked the common sea-anemone of the English coasts (*Actinia mesembryanthemum*), and how fond his little one became of it, asking for "more tinnies."

Probably the classes of animals which are of least value as food to man are those included in the sub-kingdom Arthropoda, namely, insects, arachnids, myriapods and crustacea, the multitudinous types groaped together as *Vermes*, or worms, and the uni-celled organisms, or Protozoa. Some of the larger crustacea, known as crabs, lobsters, crayfish and shrimps, are eaten as delicacies, and it is probable that many other species are equally edible, but the vast majority of the class is only of value to man inasmuch as it furnishes food for larger marine animals.

Insects are eaten by many wild tribes. Some of the Indians of the Pacific coast find in the abundance of grasshoppers that plague the white man, an abundant store of food. Similar Orthoptera are largely consumed by the

natives of South Africa, and those of some of the Sunda Isles esteem dragon-flies a great delicacy, catching them, according to Wallace, on birdlimed twigs. Though there can be comparatively little nutriment in the soft bodies of insects, yet there is no reason for the horror with which they are regarded, as articles of food, by the Aryan races. A fancy for the flavor of the Rocky Mountain locust would go far toward decreasing the devastation of that dreaded pest.

Some of the marine worms are accounted delicacies by certain tribes, but the greater part of the varied forms belonging to the sub-kingdom must be regarded, so far as they are useful to man at all, as only indirectly so through their consumption by animals he feeds upon. The same may be said of the Protozoa, which, swarming in countless numbers in sea and river, lake and marsh, furnish food for the creatures above them.

Putting aside all question of protection or preservation of plants and animals now used as food, the examples adduced are sufficient to show that the range of foods might, with advantage, be greatly extended.

Much remains to be learned respecting the diseases and bodily states of cold-blooded animals and of the invertebrata before we can use them for food with the same confidence with which we eat beef, mutton or poultry. The diseases of the higher animals are, to a great extent, similar to our own, and we have learned how to discriminate; but we do not recognize the diseases of fishes, crabs and shellfish. The stories of poisonous fish probably arise from this source. Every year we hear of cases of poisoning, well authenticated, from eating mussels, lobsters or other crustacea, or mollusks, which are usually healthy food. All these creatures are subject to diseases which we have not yet studied, and it may be that at certain seasons, such as immediately after reproduction, some of them are unfit for food. This is one well-grounded cause of prejudice, but one which will be removed as our knowledge of the lower forms of life extends.

The animal and vegetable world furnish us with other things besides food. Materials of other descriptions furnish, by their manufacture, a means of procuring food to some, while the articles manufactured are of use to all. Commerce, which has made us familiar with foods previously unknown, has helped us still more in this direction, yet when we consider the great variety of vegetable and animal life, we cannot but believe that much more remains to be discovered, or, at least, utilized.

Other nations, many of them but semi-civilized, others barbarous, have, in these things, been our teachers. As maize and potatoes were known to the Indians before we learned to use them, so was *Phormiumtenax* to the Maoris, and cotton to the Hindoos and Chinese.

When it is remembered what vast industries depend upon the supply of fibrous plants, and, that a fibre with different qualities, as it could be applied to new uses, would start a new branch of trade; when we see how extensive are the manufactures carried on from gum-resins like caoutchouc, or gutta-percha, we must acknowledge that the discovery of a fiber or a resin with new uses would furnish a livelihood to many additional workers. Take paper for example. Until lately this article was made from linen rags, but as the supply of that material fell short of the demand, cotton waste, straw, the Yucca plant, and other vegetable materials came into use, and it is evident that it can be made from almost any fibrous substance reduced to a pulp. Few are the plants that cannot be utilized by man. If valueless for food or for building purposes, a fiber, a gum, an essential oil, a medicinal product, may be found in most.

The constantly-increasing stock of geographical and botanical knowledge brings new materials into the notice of scientists, and the constantly increasing needs of mankind brings them slowly into public notice. The secretion lately found in Arizona, upon the branches of *Larrea Mexicana*, and of another plant, may yet enable us to dispense with the imported lac from Asia. Chemically the two seem identical; practically the despised Indian, here again our teacher, has long ago proved its use in the mending and making of vessels for cooking purposes.

Here is a case of a new material furnished by the animal kingdom, for it appears almost certain that the secretion, like that of wax or honey, is elaborated by the insect from the juices of the plants it feeds upon. Insects, so little used for food, so terribly destructive to our food plants and annoying to our domestic animals, may yet yield to us many useful materials; may yet prove in this respect among the most useful of organisms. Silk, honey, wax, gum-lac, cochineal, all are insect products, elaborated by insects from plants; and the last two are the produce of *coccidæ*, those destroyers of our orchards and orangeries. Does not this point a way to the utilization, in some cases, of our insect pests?

The higher animals may not furnish us with many additional materials. Horn, hair, fur, wool, hides, feathers, bone, ivory, have their known uses. Improvement here is to be looked for rather in new uses for known materials than in the discovery of new ones. But the lower animals may yet yield us many useful substances. The great treasure house of the sea holds more than we have yet learned the use of. Shells, corals, the honey axes of soft-corals, and many other portions of marine animals, may be utilized for something more than show; and other secretions may be found as useful as those of the sepia. But though the number of useful species—useful either directly or indirectly—is so large that it includes probably the greater portion of existing organisms, yet some are far more useful than others, and some are directly injurious to more useful organisms. Such species need not be cultivated, except where they do not come into direct competition with more useful ones; but their consumption or use by man would diminish their numbers and give room for the more useful forms, which are now often permitted by man, even in his own cultivated fields, to be crowded out by the less useful. —*Scientific Press*, Cal.

Two eggs of the extinct great auk were sold by auction in Edinburgh recently, both being purchased by Lord Lilford, one at £100, the other at 102 guineas, probably the largest sum ever paid for a single egg, with the exception of that of the moa, a single specimen of which was sold at the same place in 1865, for £200.

Progress in Utilization of Solar Heat.—Since May, last year, M. Mouchot has been carrying on experiments near Algiers with his solar receivers. The smaller mirrors (0.80 m. diameter) have been used successfully for various operations in glass, not requiring more than 400° to 500°. Among these are the fusion and calcination of alum, preparations of benzoic acid, purification of linseed of oil, concentration of syrups, sublimation of sulphur, distillation of sulphuric acid, and carbonization of wood in closed vessels. The large solar receiver (with mirror of 3.80 m.) has been improved by addition of a sufficient vapor chamber and of an interior arrangement which keeps the liquid to be vaporized constantly in contact with the whole heating surface. This apparatus on November 18, last year, raised 35 litres of cold water to the boiling point in 80 minutes, and an hour and a half later showed a pressure of eight atmospheres. On December 24 M. Mouchot with it distilled directly 25 litres of wine in 80 minutes, producing four litres of brandy. Steam distillation was also successfully done, but perhaps the most interesting results are those relating to mechanical utilization of solar heat. Since March the receiver has been working a horizontal engine (without expansion or condensation) at a rate of 120 revolutions a minute, under a constant pressure of 3.5 atmospheres. The disposable work has been utilized in driving a pump which yields six litres a minute at 3.50 m. or 1,200 litres an hour at 1 m., and in throwing a water-jet 12 m. This result, which M. Mouchot says could be easily improved, is obtained in a constant manner from 8 A. M. to 4 P. M., neither strong winds nor passing clouds sensibly affecting it.

THE AMERICAN SOCIETY OF MICROSCOPISTS.

The third annual meeting of the American Society of Microscopists, the largest representative body of miscroscopists in America, will begin at Detroit, Mich., the 17th day of this month (August), and will continue four days.

The circular of the Society announces that the headquarters will be at the Detroit Female Seminary, No. 82 Fort Street West. Ample arrangements are being made by the (local) Griffith Club of Miscroscopy for the comfort and convenience of its guests. Free accommodations are to be furnished the members and delegates of the American Society at private residences, and the noted hospitality of the citizens of Detroit will undoubtedly be freely dispensed to the visiting Society.

The forthcoming meeting of the Society promises to be the most successful yet held. Several valuable papers will be presented, and new and original mechanism in the construction of stands will be shown and described. Also in the preparation of microscopic objects several valuable and much needed improvements will be presented.

The circular issued by the Society extends an invitation to microscopists who are not yet members to be present, also to join the Society, and participate in its business, both scientific and executive.

The last meeting of the American Society was held at Buffalo, N. Y., one year ago, and the results, both in the attendance and character of the papers read at that meeting, were highly encouraging to the lovers of miscroscopic work throughout the country. The influence exerted by these meetings has been productive of a great amount of good. Microscopic societies have been, and are, forming throughout the country. In Pennsylvania, New York, New Jersey, Michigan and other States good working societies have lately been formed, and a corresponding interest in scientific enquiry has been aroused. This cannot but be valuable to the communities in which these societies exist. This work must not be allowed to cease, and therefore we trust the National Society may have a long lease of life.

Not only in stirring up an interest in scientific work is the American Society valuable, but in original research it will yet make its name known, as even now among its members may be found many of the leading scientific workers with the microscope in this country. The officers of the Society, and of the Detroit meeting are as follows:

President,—Prof. Hamilton L. Smith, LL.D., of Geneva, N.Y.

Vice-Presidents, { Dr. W. Webster Butterfield, of Indianapolis, Ind., and Mr. C. C. Merriman, of Rochester, N. Y.

Secretary,—Prof. Albert H. Tuttle, of Columbus, Chio.

Treasurer,—George E. Fell, C. E., of Buffalo, N. Y.

Executive Committee, { Dr. W. B. Rezner, of Cleveland, Ohio, Dr. Carl Seiler, of Philadelphia, Pa., and Dr. W. C. Barrett, of Buffalo, N. Y.

THE TAY BRIDGE DISASTER.

The report of the Court of Inquiry appointed to investigate the circumstances of the fall of the Tay Bridge last December, which was fatal to so many hundred lives, has been made public, and the result is thus summarized and commented upon by *Nature*:

There appears to be some difference of opinion amongst the members of the court respecting the scope of the inquiry and the duties placed upon them by the Board of Trade, in consequence of which two separate reports appear together, one by Col. Yolland, Chief Government Inspector of Railways, and Mr. Barlow, President of the Institute of Civil Engineers, and the other by Mr. Rothery, the Wreck Commissioner. The former report describes in detail the design and method of erection adopted in the bridge, giving also a description of the various alterations in the plan which were rendered necessary as the work progressed.

The bridge was 3,465 yards in total length, divided into 86 spans, and it was the central portion, of 3,149 feet in length, which fell on the evening of December 28. As originally designed, this central position was to consist of lattice girders of 200 feet span, carried by brickwork piers somewhat over 80 feet in height from high-water level, but as the river bottom turned out to be different from what was expected from the borings, and the difficulty of obtaining a secure foundation greater, eleven spans of 245 feet and two of 227 feet were substituted, and braced iron piers were adopted in the place of brickwork, as imposing a less weight on the foundations. It is these piers which at the inquiry chiefly received attention, as there can be little doubt that they were the immediate cause of the catastrophe. The process of floating out and sinking the caissons for these piers has already been described in these columns, and so successfully was this—certainly the most difficult and hazardous part of the undertaking—accomplished, that no suggestion of insufficient strength has been made, and in the Report it is stated that there is nothing to indicate any movement or settlement in the foundations of the piers which fell.

The caissons were lined with brickwork and filled with concrete, on which was built a hexagonal pier of masonry carried up to 5 feet above high-water mark. Upon this pier was built up six cast-iron columns secured by holding-down bolts to the masonry at the angles of the hexagon. The columns were made up of lengths united by flanges and bolts, and connected with each other by horizontal struts and diagonal ties. The up-stream and down-stream columns were each 18 inches in diameter, the remaining four, 15 inches; all were inclined 12 inches inwards at the top. The piers thus formed were from 81 to 83 feet in height from the top of the masonry to the under-side of the girders. The diagonal bracing consisted of flat bars attached to the columns by means of "lugs" cast on them, being secured at one extremity by a screw-bolt passing through the lugs and bar, and at the other by a strap provided with a gib and cotter for tightening up. The horizontal struts consisted of two channel-bars bolted back to back to a single lug on each column.

It will thus be seen that all vertical load must be borne entirely by the columns, and with the exception of the small transverse resistance of the latter the whole of any lateral pressure must be transmitted by the bracing.

Whether as designed the bridge would have been strong enough for its work if the materials and workmanship had been good throughout is very doubtful, but, as carried out, the evidence shows distinctly that it was not sufficiently substantial for the heavy traffic and severe gales to which it was exposed. When everything was tight and in good order the bridge, at the time of its inspection by General Hutchinson in February, 1878, showed great rigidity under the tests imposed by him, but by October of the same year so much slackness had made its appearance in the bracing that, besides the ordinary keying-up by driving the cotters, more than 100 packing-pieces about three-eighths of an inch thick had to be introduced in different parts.

Respecting the immediate cause of the accident the Court states—"In our opinion the weight of evidence points out the cross bracing and its fastening by lugs as the first part to yield." This we believe the calculations of Dr. Pole and Mr. Stewart, taken in connection with the experiments of Mr. Kirkaldy, are quite sufficient to establish. With a wind pressure of 30 lbs. to the square foot on the windward girder and train, and half this amount on the leeward girder, the stress on the tie-bar most severely strained, would be 16·8 tons, or 10·18 tons per square inch; again, with a wind pressure of 40 lbs. to the square foot the stress on the tie-bar would be 22·4 tons. Now, as Mr. Kirkaldy's experiments, made by order of the court on some of the tie-bars removed from the bridge, showed that they broke with a load of from 19 to 23 tons, and the corresponding lugs with a load of 23 to 25 tons, it is pretty certain that the ultimate strength of this part of the structure would be reached by a wind pressure of 40 lbs. to the square foot.

And, in addition to this, more variation is to be expected in the strength of the lugs, as some at least were admitted to be of bad manufacture, and when the pier was most severely strained it would be some of the worst lugs in the lower tiers that would be the first to yield; thus the samples taken for testing would not be likely to embrace specimens of the lowest strength, as these would probably have already given way.

Again, it does not appear necessary to assume a wind pressure of 40 lbs. per square foot to ensure the destruction of the pier; the stresses above mentioned are due merely to the statical pressure, and it can hardly be denied in the face of the evidence respecting the details of the structure that there would be a great deal of motion due to backlash over and above the elastic yielding of the material. Thus a much lower pressure would produce the effects calculated for one of 40 lbs. per square foot.

The principal conclusions arrived at by the court are that there is no indication of settlement in the foundations, that the wrought iron employed was of fair strength, though not of high quality as regards toughness, that the cast iron was fairly good, that the main girders were of sufficient strength, and that the iron piers, though strong enough to sustain the vertical load, were insufficient to resist the lateral action of heavy gales from the weakness of the cross bracing and its fastenings; that the railway company did not enforce the recommendation of General Hutchinson by limiting the speed of trains over the bridge to twenty-five miles per hour, much higher speed being frequently run; that while of opinion that the fall of the bridge was occasioned by the yielding of the cross bracing and fastenings, it might possibly have been due to the fracture of one of the outward leeward columns.

Colonel Yollard and Mr. Barlow conclude by stating "that there is no requirement issued by the Board of Trade respecting wind pressure, and there does not appear to be any understood rule in the engineering profession regarding wind pressure in railway structures; and we therefore recommend that the Board of Trade should take such steps as may be necessary for the establishment of rules for that purpose."

Mr. Rothery, in his independent report, while stating that there is an entire agreement between himself and his colleagues in the conclusions arrived at from the evidence, goes further than they, and unhesitatingly apportions the blame among the different parties concerned. On the recommendation that the Board of Trade should establish rules providing for wind pressure, he differs from his colleagues, emphatically stating that it is for the engineering profession to make them, and evidently regards the superficial character of an official inspection as no great evil.

Where French engineers have long adopted 270 kilogrammes per square metre, and many English engineers, on the authority of Rankine, the equivalent 55 lbs. per square foot, while nearly the same figure is used in America, it seems strange that so much difference of opinion should be found to exist; but one thing at least is certain, that the instruments at present in use for measuring wind pressure are exceedingly crude and liable to error, and that until these are improved and much increased in number there is little chance of being on the spot when these excessive pressures occur, or of truthfully recording them when met with.

Respecting the transfer of these responsibilities to a Government Department, we believe that such a pronstring policy would be fatal to the profession of the civil engineer; we would rather see the Board of Trade Inspection, which at least is formal and superficial, relaxed than any attempt made to increase its efficiency. The medical profession does not require a fatherly department to watch over its operations or give an opinion on an amputation; why then should the engineering profession? It cannot be too clearly understood that an engineering work cannot be successfully carried out by mere rule of thumb or even by the copious use of "Molesworth" or "Rankine"; each operation is to some extent a physical experiment, subject to known laws, but under variable conditions. The physicist and the engineer have already to a great extent established the laws for themselves, but it remains for the scientific engineer to carefully watch their operation, and thus gain that practical experience which will enable him to deal with each special case as it arises.

The conclusions we draw from the evidence and report are that the design of the piers was most imperfect, cheapness appearing to be the ruling element in every detail, a cheapness too that must have been completely delusive, as any money saved in first cost would soon, in such a rickety structure, have been swallowed up in maintenance. At nearly all points an absence of consideration for small details is most apparent, indicating probably that these were intrusted to some subordinate, who failed to appreciate their importance.

It is very far from our object in this article to hold up any particular individuals to blame for this disaster, but we should like to point out on whom the responsibility should rest if such a thing should occur again.

It would be quite impracticable for the Board of Trade to exercise such supervision over the selection of the material and the execution and erection of a large work throughout its progress, as would render its certificate of any value; we believe, therefore, that the undivided responsibility should rest on the engineer. Any dishonesty on the part of the contractor or his workmen—and we are sorry to believe this still exists in some cases—could be easily rendered hazardous by legal penalties.

Doubtless with the keen competition of the present day things must be "cut finer" than they used to be: but while we would remove any arbitrary restrictions imposed by Government on the judgment of those who ought to be best able to appreciate the particular conditions of their own work, we should be very sorry to see the introduction of flimsy structures or reckless traffic arrangements without it being understood on whom the responsibility rested in case of failure.

A letter recently sent to Professor Plantamour, director of the Geneva Observatory, gives the details of a singular phenomenon observed at Bonneville on the 25th of April. It was noticed during a rain storm, that the drops of water falling upon dark clothes, linen, umbrellas, left a dirty yellow spot verging on brown. The matter was given over to M. de Candolle, for investigation, who found that the powder which colored the yellow rain, contained only organic elements of vegetable origin. Observed dry, or in pure water, these *débris* had mostly a yellowish color, but some were colorless. They were generally formed of cells of small diameter, upon the walls of which were granulations consisting of the finest particles of the pulverulent matter of the rain drops. The advanced state of disaggregation of all these vegetable *débris*, did not allow of the determination of their origin; but the minuteness of the cells seemed to indicate that they belonged to young tissues. Amongst the fragments, with form so varied and irregular, were found some spores of cryptogams, but no grains of pollen were met with.

M. Dines has calculated that the amount of dew deposited on the ground in the course of a year would be represented by a layer of water about 40 millimetres (1.6 in.) in height, equivalent to 40 litres per square metre.

The Royal Society of New South Wales now numbers 430 members, exclusive of honorary and corresponding members. Mr. G. Bentham, Dr. Darwin, Prof. Huxley, Prof. Owen and Sir. J. D. Hooker have been elected honorary members, and Mr. R. Etheridge, jun., a corresponding member. The Clarke memorial medal for 1878 has been awarded to Prof. Owen, for 1879 to Mr. G. Bentham, and for 1880 to Prof. Huxley, for their contributions to palæontology, botany and natural history of Australia.

BOOKS RECEIVED.

THE CONSTRUCTION OF GAS-WORKS AND THE MANUFACTURE AND DISTRIBUTION OF COAL GAS. By William Richards, C. E. 6th edition Crosby, Lockwood and Co., 7, Stationer's Hall Court, London. 1880.

This is a new and enlarged edition of the work originally written by Samuel Hughes, C. E., but now enlarged, re-written by William Richards, C. E., who has brought his facts down to the most recent knowledge of the subject.

At a time when a revolution in our methods of illumination has become an established fact, and the death knell of gas has already been sounded, it is very convenient to find a hand-book full of the most valuable details respecting that method of illumination, written by one who is evidently a master of the subject. We find a great number of good engravings and many valuable tables. In view of the recent serious explosion of a gas main in London, England, the chapter on "Gas explosions" will be read with inrerest.

ELECTRIC LIGHT: ITS PRODUCTION AND USE. By J. W. Urquhart, C. E. Edited by F. C. Webb, M. I. C. E., M. S. T. E. Crosby, Lockwood & Co., London. 1880.

The object of the author is to present for general reading an account of the various methods of obtaining the electric light, both from voltaic and galvanic batteries, and it also treats of the various forms of dynamo-electric machines.

This work will serve the very useful purpose of placing within reach of those who are not acquainted with the history and growth of electric lighting, a clearly written description, well illustrated with wood engravings. It is not a text book, and the author makes no pretentions to teach electricians the art of electric lighting, but it is, in fact, a popular guide to the subject.

The rapid development in the various forms of electric lighting led to a re-arrangement of the book, even while it was being written; it is not therefore surprising to find that on certain points the work is already obsolete. The chapter on the Edison electric lamp was written twelve months since, and is devoted chiefly to his experiments with incandescent platinum, which has been long since abandoned, while the author merely speaks of the carbon lamps to prophesy their failure. Reading this, at this date, when every difficulty in the way of their practical use has been removed, and arrangements are in progress to produce them in sufficient numbers to permit their general adoption, we cannot but regret that prejudice has been allowed to derange the better judgment of those who have assumed to lead public opinion on this subject.

We do not propose to examine too critically what is admitted to be a popular work, and while we are not in accord with much we find in the book, we have no doubt that the numerous wood-cuts of electric generators and other apparatus will be most useful to those who desire to acquaint themselves with the various methods of electric lighting.

MANUAL OF THE ALKALI TRADE, INCLUDING THE MANUFACTURE OF SULPHURIC ACID, SULPHATE OF SODA AND BLEACHING POWDER.—By John Lomas. Crosby, Lockwood & Co. London. 1880.

This is a handsome volume of three hundred and fifty pages, containing two hundred and thirty-two illustrations and working drawings, and provides a complete hand-book for those intending to manufacturer Alkalis, or for those already in the field who desire to improve their plant, or become practically acquainted with the latest developments of the trade; it also may be useful for manufacturers to place in the hands of their managers and foremen, as a useful guide in their daily rounds of duty.

The author appears to have had fifteen years' of practical experience as an alkali manufacturer, during which time he states he has erected new plants, remodeled old works, and trained managers. We advise all engaged in the alkali manufacture, to procure this most practical work, as from the examination we have made of it, we feel sure a perusal will be the means of saving infinite time, patience and labor.

NOTES AND QUERIES.

[1.] In reply to the Query of J. H. G. in regard to Tuckahoo or Indian Bread, I regret not being able to give all the particulars asked for, but the following extract from the Treasury of Botany may be useful:

"Tuckahoo is the Americo-Indian name for a curious tuberous production, which is dug out of the ground in several parts of the United States, and which has been referred by Fries to the genus *Pachyma*. Like *Sclerotium*, however, *Pachyma* has no fruit, and there is some reason to doubt whether it has any pretensions to be classed with *Fungi* at all. It is composed entirely of pectic acid, and it is very probable that it is a peculiar condition of some root, though of what plant has not at present been ascertained. One similar production at least has been found in China, where it is supposed to possess medicinal virtues; and there is reason to believe that another exists there, attaining a diameter of several inches like the American Tuckahoo. As may be supposed from its chemical constitution, it affords a nutritive article of food, for which purpose it is dug up by the natives like the *Mylitta* or Native Bread of Tasmania, with which, however, it does not correspond in character. It is also employed occassionally as a material for making jelly, for which it is well adapted, the pectic acid of currants and other fruits being the principle which disposes their juice when boiled to form a jelly-like mass. The principal objection which is brought forward against the suppossed phaenogamous origin of the production is the absence of all trace of vascular or cellular structure like that of phaenogams, or of bark, except such as may be suppossed to arise from mere contact with the soil; but the dissimilarity of its structure and that of Fungi is quite as great, and the conversion of a fungus into pectic acid would be more surprising." J. R.

GENERAL NOTES.

CURIOUS ELECTRIC PHENOMENON.—At about 4.30 P. M. this day a severe thunder storm with a deluge of rain came up from the north-west, and lasted about an hour. At 5.30 my wife was standing at the window watching the receding storm, which still raged in the south, just over Leicester, when she observed, immediately after a double flash of lightning, what seemed like a falling star, or a fire-ball from a rocket, drop out of the black cloud about 25° above the horizon, and descend perpendicularly until lost behind a belt of trees. The same phenomenon was repeated at least a dozen times in fifteen minutes, the lightning flashes following each other very rapidly, and the thunder consisting of short and sharp reports. After nearly every flash a fire-ball descended. These balls appeared to be about one-fifth or one-sixth the diameter of the full moon, blunt and rounded at the bottom, drawn out into a tail above, and leaving a train of light behind them. Their color was mostly whitish, but one was distinctly pink, and the course of one was sharply zig-zagged. They fell at a rate certainly not greater than that of an ordinary shooting star. I have never witnessed a phenomenon of this kind myself, but my wife is a good observer, and I can vouch for the trustworthiness of her report. F. T. MOTT.

Bristal Hill, near Leicester, June 22, (Nature).

MM. LE BON and NOEL have extracted from tobacco smoke the following products, which they recently presented to the French academy in three flasks: 1, Prussic acid; 2, an alkaloid of agreeable odor, but as poisonous as nicotine; 3, aromatic principles still undetermined, but contributing, with the alkaloid mentioned, to give tobacco smoke its perfume. The alkaloid in question is thought to be identical with a compound, collidine, the existence of which has been observed in the distillation of various organic substances, but whose physiological and toxical proprieties have been overlooked.

SATURDAY, AUGUST 14, 1880.

CONTRIBUTIONS TO ENCEPHALIC ANATOMY.

BY E. C. SPITZKA, M.D.

Having, through a piece of good fortune, come into the possession of a living iguana, and thence obtained the brain and cord in a perfectly fresh condition, I was enabled to make a study for the first time of the remarkable brain of this saurian.

As regards the exterior of the encephalon, it presents nothing very different from that of any other higher reptile. On a lateral view, however, it exhibits a much acuter basilar incurvation, approximating to the bird's brain in this respect. As in birds, also, the optic nerves leave the skull directly on emerging from the chiasm. It is remarked also that the optic lobes are far larger than in any reptile or bird thus far examined by anatomists; in fact, excluding the case of the finny tribes, it may be said that the iguana possesses the largest optic lobes in the animal kingdom. They are as massive in their grey and white tissues, and nearly as voluminous as the cerebral hemispheres.

The olfactory lobes and bulbs offer nothing special for consideration.

On a transverse section through the cerebral hemispheres, I am able to identify the component parts of the cornu ammonis of the mammalia. It appears that the medial thin wall of the cerebral vesicle corresponds, with its layer of closely packed pyramidal nerve cells, to the *stratum corporum nervorum arctorum* of Kuppfer, and it is indeed separated from the cortical layer of the convexity, which I believe to correspond, as far as the thin part extends, to the *sigma* of the cornu. At the lower end of the thin-walled vesicle, where a transition of nerve fibres from the *stratum corporum nervorum arctorum* (?) takes place, to the thalamus, and which therefore corresponds to the fornix, there is an accumulation of molecular nerve substance, projecting outwards into the ventricular cavity. This may represent one of the thalamic tubercles; I regard it as much more probable, however, that it corresponds to the body of the so-called fascia dentata.

Now, in sections exhibiting the above features, I find also another which is highly important, in so far as it tends to overthrow another one of the *dicta* on whose strength the sauropsidean and mammalian brains are distinguished. Immediately underneath the median longitudinal fissure, but *over* the third ventricle, there passes a fasciculus of white fibres, uniting the two hemispheres, and particularly that portion of each which corresponds to the cornu ammonis. This is unquestionably the corpus callosum, whose first appearance in the embryo and the lower mammalia we know to be intimately associated with the development of the cornu ammonis.

But it is when we reach the mesencephalon and the region posterior to it, that we discover the most remarkable features of this brain.

As in some other saurians, the cerebellum instead of being curved backward, and constituting a cap over a part of the lateral ventricle, as in the alligator and chelonia, is bent forward, and bound to the posterior face of the optic lobes by the arachnoid filaments. On separating and drawing it backward, thus making it correspond artificially in position with the cerebellum of the alligator, we find that between the optic lobes and the cerebellum there are two pairs of tubercles.

One of these pairs, which I have found as a concealed mass in turtles, and as a very distinct elevation in the alligator, ophidia and pseudopus, I was familiar with, and I had no hesitation in describing it as the post-optic ganglia corresponding to the posterior pair of the corpora quadrigemina. The other was at first new to me, but after a careful comparative study I found that it was nothing but an unusually large, and therefore more prominent representative of a ganglionic mass which I have noticed in fair development in the turtle, and which is even represented in an atrophic condition with the mammalia. As the pair of tubercles in the iguana lies intermediate to the optic and post-optic lobes, I propose for it the name of inter-optic lobes.

On a dorsal view these different parts lie about as follows: In front are the massive optic lobes touching each other broadly on the middle line, so that their posterior margins form a continuous semi-lunar curve, convex behind. Behind each optic lobe, and bulging out somewhat, laterally, we have the smaller but distinct post-optic lobes, which fail to come in contact in the median line, so that a shallow groove would separate them, if it were not filled out by another structure now to be described.

If we imagine the median furrow separating the optic lobes prolonged between the post-optic lobes, and crowd two little pea-shaped eminences on each side of this imaginary median line, so that the latter are bounded in front by the optic lobes, on the outside by the post-optic lobes, and behind by the cerebellum, we will have the precise situation of the inter-optic lobes. These eminences are not so remarkable for their absolute size (their surface extent being only half that of the optic lobes) as for the distinctness of their demarcation. I have obtained sections through their posterior third, in which these bodies are shown to be absolutely free.

Other sections further forward show that these ganglia crop out of a specialized division of the central tubular grey of the aqueduct, and that the visible eminences do not represent the true extent of the ganglia.

The trochlearis nerves arise behind the inter-optic lobes, and passing forwards and downwards, lie in the furrow between the optic and post-optic lobes, as in other reptiles. It is well known that in the mammalia they pass down behind the post-optic lobes. I look on this as an incidental and insignificant variation.

The remainder of the isthmus shows nothing especially noteworthy. The remarkable size of the oculo-motor nuclei, and the gigantic dimensions of their almost star-like multipolar nerve-cells, merits mention, as well as the fact that in this animal the nuclei of the third and fourth pairs constitute a common cell mass, unlike the relation in the mammalia, and that the third and fourth pairs arise almost in the

same plane, the third from the ventral, the fourth from the dorsal extensions of the common nucleus.

I would call attention to the fact that the average dimensions of the cell nuclei of the auditory nerve nucleus equal those of the motor nuclei of the medulla and cord, and exceed some of them, and that the same statement applies to the cells as a whole. I make this statement in view of the recent communication of Dr. Mason before the American Neurological Association, though I do not claim to make it on the same basis of careful and extensive micrometric observations that his communication was based on, but on a general impression derived from repeated examinations which I think are sufficient to determine palpable differences.

The present preliminary report is taken from a communication made by me to the *Journal of Nervous Diseases* for last June, but I trust before long to submit to your readers a more exhaustive and illustrated record of this interesting and suggestive piece of cerebral anatomy.

DRY "MOUNTS" FOR THE MICROSCOPE.

BY PROFESSOR H. L. SMITH, HOBART COLLEGE, N. Y.

II.

In a former paper, SCIENCE No. 3, I made a few remarks upon this subject, and described the methods which I had found tolerably successful, viz.: the rings made of shellac and lampblack, and those punched out of gutta-percha tissue. The former appear to answer quite well, and the changes, if any, are very slight, yet I have, in a very few cases, observed a deterioration after the lapse of a year or so, probably from imperfect manipulation. Although I have not myself observed any great change in the gutta-percha mounts, I am not certain that they will stand prolonged use with immersion objectives without injury. I have mounted many specimens of delicate test objects for the Messrs. Spencer, and they are decidedly of the opinion that the shellac ring is the better for durability, and I am informed by Mr. Gundlach that the gutta-percha ring will not stand cedar oil. Mr. Phin has suggested that in time the gutta percha tissue will disintegrate. I have not yet noticed this, and do not think it will happen under the cover of a "mount" especially if protected by a ring of cement subsequently applied. If, however, such disintegration does, in time, happen to the tissue, this will be a great objection to its use. I have found that the "tissue" becomes so charged with electricity by handling, and also by the punching, that it interferes seriously with the latter operation, and thus makes it necessary to place strips of the "tissue" on thin moistened strips of paper, and to punch out both at the same time. The preparation of the shellac rings by the turn table obliges one to keep on hand a large stock all the time to insure perfect drying, and to have them always ready. I am obliged to have some 1000 or 1500 on hand in advance, and this necessitates a considerable outlay in stock, which will not always be convenient for amateurs. For the above reasons I now propose a new process which appears to meet all the desired wants, and which combines the advantages of the shellac cement and the gutta-percha rings.

The very simplicity of this process causes me to wonder why it was not thought of before. I take a sheet of thin writing paper, white or colored, and dip it into thick shellac varnish (shellac dissolved in alcohol), and hang it up to dry. When thoroughly dry it should have a good glaze of the varnish on it (different thickness of paper can be used according to depth of cell required). Out of this shellac paper I cut my rings, and these can be made in any quantity, and kept for any time. The process of mounting is simple. The slide is cleaned, and the flat paper ring placed in the centre; on this the cover is placed, having the object dried on it, and the two are held together by the forceps and gently warmed; this serves to attach the ring to the slide, and cover, at several points, so that the forceps may now be laid aside. The next step is to take a glass slip, (another slide), and laying this on the cover, to grasp the two slides at each end by the finger and thumb of the two hands, and pressing them tightly together, to warm the slide gently; by looking at the ring obliquely, on the under side, one can tell at once, when all the air is pressed out, and the adhesion is complete between the cover and the ring, and also the ring and the slide, and they must be held together a moment or two to cool. If the lac is sufficiently thick on the paper the adhesion takes place quickly, and with moderate heat, and there will be no danger of breaking the cover, unless it has been warped in the process of warming, which will sometimes occur when very thin glass has been heated too much for the purpose of burning off the organic matter, or when the support is too small in diameter, or when it is not flat. I think I may be able to induce the leading opticians to manufacture this paper and also the rings for sale; for special purposes the paper might be printed beforehand, so that, when mounted, the ring would show on the under side the name of the preparer, or of the object. I cannot conceive of anything more satisfactory than these rings. Many large objects which would be crushed if one used only the shellac rings made on the slide, by the use of the turn table, by the giving way of these by softening, and under the necessary pressure for attaching the cover, are perfectly protected by the paper rings. I am satisfied that the balsam mounts will be much less frequently used, as soon as we can find some *sure* dry process. The diatoms, as a rule, show much better when mounted dry, and with whole frustules, exhibiting both the side and the front view, also the mode of attachment, etc. The dry mounts are certainly to be preferred when they are desired for anything except pretty objects, and even for this latter purpose there is often a very great difference in favor of the dry mount. Although I have not used these shellac paper rings for any very great length of time, yet I can see no reason why they should not be equal to the simple shellac ring for durability, and very much superior to it in other respects.

SCIENCE AT BREAKFAST.

By The Editor.

The sterling goodness of Dr. Johnson's heart, notwithstanding many apparently blunt demonstrations to the contrary, was never more clearly demonstrated, than when he remarked to Boswell, "I encourage this house, for the mistress of it is a good civil woman, and has not much business."

The house referred to was the "Turk's Head Coffee House." But coffee houses, nay coffee drinkers, have much changed in outward form since the days of the sturdy old philosopher. The beau and the belle no longer, in picturesque costumes, discourse scandal, sipping the Eastern beverage from exquisite specimens of china ware, and tea and coffee, no longer a luxury, are now enjoyed by the toiling millions, and esteemed a blessing by all classes.

Although tea and coffee is universally used by the civilized nations of the world, few understand the natural potent properties of these substances, or are even conscious of their powerful action upon the human system, and as it is a subject interesting to so many, I offer the following sketch, treating of the more important points.

Coffee, tea and chocolate all contain in common a nitrogenised basis, to which they owe most of their important chemical properties. Tea and coffee even contain the self-same basis, denominated indiscriminately *theine* or *caffeine*. In chocolate the cocoa principle called *theobromine* is richer in nitrogen than the *theine*.

The chemical constituents of these substances are as follows: While in tea the basis is combined with tannic acid, in coffee it forms a salt, with a peculiar tannic acid, containing a greater proportion of nitrogen, which together with tannio-caffeic acid is united with potash into a so-called double salt. Tanno-caffeic acid when roasted, develops the agreeable odor of coffee.

Not only the same basis, but also two similar organic acids, one contained in tea, the other in coffee, increase the conformity, between the leaves of the former and the beans of the latter.

Legumin, cellulose, gum, sugar, citric acid in addition to oleine, and what is called palm-fat, accompany the organic acids and the theine of the coffee beans.

But the tea leaves, apart from the basis and the acids, are composed of albumen, cellulose, gum and wax, the green pigment of the plant and the volatile oil of tea

This peculiar oil is the principal source of the aroma of tea, by which, in spite of the conformity between tea and coffee, it essentially differs from the latter.

The inorganic constituents of tea and coffee are moreover different. While in coffee, chlorine, phosphoric and sulphuric acids are combined with potash, lime, magnesia and oxide of iron; tea contains another inorganic acid besides, consisting of manganese and a large proportion of oxygen.

So much for the chemical constituents of coffee and tea. Let us now examine their peculiar properties and nutritive qualities.

Chocolate from its large proportion of albumen is the most nutritive beverage, but at the same time from its quantity of fat, the most difficult to digest. But its aromatic substances strengthen the digestion. A cup of chocolate is an excellent restorative and invigorating refreshment even for weak persons, provided their digestive organs are not too delicate. Cardinal Richelieu attributed to chocolate his health and hilarity during his later years.

Tea and coffee do not afford this advantage. Albumen in tea leaves, and legumin in coffee berries, are represented in very scanty proportions, for while in the former the albumin is coagulated by boiling water, in the latter the legumin is prevented from being dissolved by the lime with which it is combined.

The praise of tea and coffee as nutritive substances is, therefore, hardly warranted, because, as restoratives for the body, the alimentary principles and not the elements are to be taken into account. The former principle cannot be ascribed to "Theine," which is excreted again as urea with surprising rapidity, and to this swift transformation tea and coffee owe their diuretic action, which is considerably assisted by the warm water of the infusion.

Tea and coffee, though of themselves not difficult of digestion, tend to disturb the digestion of albuminous substances by precipitating them from their dissolved state. Milk, therefore, if mixed with tea or coffee, is more difficult of digestion than if taken alone, and coffee alone without cream promotes digestion after dinner by increasing the secretion of the dissolving juices.

The volatile oil of coffee and the empyreumatic and aromatic matters of chocolate *accelerate* the circulation, which, on the other hand, is *calmed* by tea.

Tea and coffee both excite the activity of the brain and nerves.

Tea, it is said, increases the power of digesting the impressions we have received, creates a thorough meditation, and, in spite of the movements of thoughts, permits the attention to be easily fixed upon a certain subject; a sense of cheerfulness and comfort ensues, the functions of the brain are set in motion, the thoughts are concentrated and not apt to degenerate into desultoriness.

On the other hand, if tea is taken in excess, it causes an increased irritability of the nerves, characterized by sleeplessness, with a general feeling of restlessness and trembling of the limbs; spasmodic attacks may arise, with difficulty of inspiration in the cardiac region. The volatile oil of tea produces heaviness in the head, first manifesting itself in dizziness and finally in stupefaction.

These symptoms have been called an evidence of a real tea intoxication. Green tea, which contains much more of the volatile oil than the black, produces these obnoxious effects in a far higher degree than the latter.

While tea principally revives the faculty of judgment, and adds to this activity a sensation of cheerfulness, coffee acts also on the reasoning faculties, but without communicating to the imagination a much higher degree of liveliness.

Susceptibility to sensuous impressions is intensified by coffee; the faculty of observation is therefore increased, while that of judgment is sharpened, and the perceptions adopt more quickly certain forms, activity of thoughts and ideas is manifested, a mobility and ardor of wishes and ideals, which are more favorable to the shaping and combination of already premeditated ideas than to a calm examination of newly originated thoughts.

Coffee, also, if taken in excess, produces sleeplessness and many baneful effects very similar to those arising from tea drinking. Coffee, however, produces greater excitement, and a sensation of restlessness and heat ensues. For throwing off this condition fresh air is the best antidote.

Much depends upon the proper roasting of coffee, in which process it loses weight but increases in bulk, two pints of unroasted berries giving three pints when roasted.

Several empyreumatic substances created by roasting produce the reddish or brown color, and the tanno-caffeic acid, altered by roasting, produces the aroma; the sugar loses a part of its amount of hydrogen and oxygen, and is thus decomposed into burnt sugar or caramel.

Liebig states that the berries should be roasted until they are of a dark brown color. In those which are too dark there is no caffeine; and if they are roasted black, the essential parts of the berries are entirely destroyed, and the beverage prepared from them does not deserve the name of coffee. This fact should be noted by drinkers of *caffe-noir*.

The berries of coffee when once roasted, lose every

hour, somewhat of their aroma in consequence of the influence of the oxygen of the air, the porosity of the roasted berries allowing it to penetrate easily. Liebig recommended a process by which much of this pernicious change can be avoided. "Strew," says he, "over the berries, when the roasting has been completed, and while the vessel in which it has been done is still hot, some powdered white or brown sugar; half an ounce to one pound of coffee is sufficient."

The sugar melts immediately, and by well shaking, or turning the roaster quickly, it spreads over all the berries, and gives each one a fine glaze, impervious to the atmosphere.

They have then a shining appearance, as though covered with a varnish, and in consequence lose their odor entirely, which, however, returns in a high degree, as soon as they are ground.

After this operation, they are to be shaken out rapidly from the roaster, and spread on a cold plate of iron, so that they may cool as soon as possible.

If the hot berries are allowed to remain heaped together, they begin to sweat, and when the quantity is large, the heating process by the influence of the air increases to such a degree, that the coffee is permanently damaged."

In this city I have often observed that coffee is roasted to too high a color, and filled into sacks too quickly, before the process of cooling is complete.

The preparation of coffee as a beverage is accomplished by three processes: first, by *filtration;* second, by *infusion;* and third, by *boiling*.

Liebig states that filtration gives often, but not always, a good cup of coffee. When pouring the boiling water over the ground coffee is done slowly, the drops in passing come in contact with too much air, whose oxygen works a change in the aromatic particles, and often destroys them entirely.

The extraction moreover is incomplete; instead of 20 to 21 per cent., the water dissolves only 11 to 15 per cent., and 7 to 10 per cent. is lost.

Infusion is accomplished by making the water boil and then putting in the ground coffee, the vessel being immediately taken off the fire and allowed to stand quietly for about 10 minutes.

This method gives a very aromatic coffee, but one containing very little extract.

Boiling is the custom in the East, and yields excellent coffee. The powder is added to the water when cold, and then placed over the fire and merely allowed to boil a few seconds. The fine particles of coffee are drunk with the beverage. If boiled long, the aromatic parts are volatilized and the coffee is then rich in extract, but poor in aroma.

Further, Liebig gives what he calls the best method; this I produce, not because I think the plan will make a coffee acceptable to most palates, but because Liebig speaks highly in its praise, and states that it is without those heating properties, common to most preparations, causing it to be rejected by many in delicate health.

"My method," said Leibig, "is the union of the second and third. The usual quantities of coffee and water are to be retained; a tin measure containing half an ounce of green berries, when filled with roasted ones, is generally sufficient for two small cups of moderate strength, or one so-called breakfast cup; one pound of green berries, equal to 16 ounces, yielding after roasting 24 tin measures (of ½ ounce each) for 48 small cups of coffee.

With three-fourths of the coffee to be employed, (after being ground), the water is made to boil for 10 or 15 minutes.

The one-quarter of the coffee which has been kept back, is then flung in, and the vessel immediately withdrawn from the fire, covered over and allowed to stand from five to six minutes.

In order that the powder on the surface may fall to the bottom, it is stirred around, the deposit then takes place, and the coffee poured off ready for use. In order to separate the dregs more completely, the coffee may be passed through a clean cloth, but generally this is not necessary and often prejudicial to the pure flavor of the beverage.

The first boiling gives the strength, the second addition the flavor. The water does not dissolve more than the fourth part of the aromatic substances contained in the roasted coffee.

The beverage when ready ought to be of a brown black color, somewhat like chocolate thinned with water; this want of clearness in coffee thus prepared, does not come from the fine grounds, but from a peculiar fat resembling butter, about 12 per cent. of the amount the berries contain, and which, if over roasted, is partly destroyed.

In the other methods of making coffee, more than half of the valuable parts of the berries remain in the grounds, and is lost.

"Judging," said Liebig, "as favorably of my coffee as I do myself, its taste is not to be compared with that of the ordinary beverage, but the good effects which my coffee has on the organism should be taken into consideration.

Many persons who connect the idea of strength or concentration, with a dark color, fancy my coffee to be thin and weak, but these were at once more favorably inclined, when I gave it a dark color by means of burnt sugar."

Adulteration of coffee sold in a ground state, is largely carried on, especially of that sold to the poorer classes—out of 34 samples purchased by an English analytical chemist in London, 31 contained chickory, chickory itself being adulterated with all manner of compounds.

There is no falling back, says Dr. Hopall, upon tea and chocolate, as these seem rather worse off than the coffee. Tea is not only adulterated here, but in China, while as to chocolate, the processes employed in corrupting that manufacture, are described as "diabolical." It is often mixed with brick dust to the amount of 10 per cent., ochre 12 per cent., and peroxide of iron 22 per cent., and animal fats of the worst description, while the names "Flake," "Rock," "Granulated," "Soluble," "Dietetic," are merely employed as disguises to cover the fact that they are compounds of sugar, starch and other substances.

The microscope is the most effective instrument in the work of detecting adulterations, the microscopic appearance of coffee and chickory being very distinctive, while the presence of starch granules discovers the particular cereal employed in adulterations.

The adulteration of coffee by the addition of chicory is fraudulent but harmless, chickory containing little that is injurious to the system; coffee indeed is the more active substance of the two; its effects on some delicate constitutions being so strongly manifested, that without a violation of language, it may almost be designated a weak poison.

Some persons positively like the flavor of chickory, others detest it; its presence, however, can be at once detected by its peculiar odor, and if thrown into cold water it imparts a deep tint, which coffee does not.

In conclusion, I offer a useful receipt of Leibig's for preparing coffee in a ground form for special cases, such as marches and journeys, where it is inconvenient to be burdened with the necessary machines for roasting and grinding; by this process its aromatic properties can be preserved.

One pound of the roasted berries is reduced to powder, and immediately wetted with a syrup of sugar, obtained by pouring on three ounces of sugar, two ounces of water, and letting them stand a few minutes.

When the coffee powder is thoroughly wetted with the

syrup, two ounces of finely powdered sugar are to be added, mixed well with it, and the whole is then to be spread out in the air to dry. The sugar locks up the volatile parts of the coffee, so that when it is dry they cannot escape.

Ground coffee prepared in this way, and which lay exposed to the air for one month, yielded, on being boiled, as good a beverage as one made from freshly roasted berries.

I have described the mental influence of tea and coffee; much could be written on their influence upon modern society and civilization.

Anne Boleyn makes mention in one of her letters of having partaken of half a pound of bacon and a quart of beer for breakfast; now, after making due allowance for custom and habit, it must be confessed that modern ladies must rise from their morning meal of a cup of coffee with some bread and butter and an egg, with many different sensations and sentiments to those experienced by the fair Queen after her more masculine repast.

BACTERIA IN THE AIR.

M. Miquel has succeeded in seizing and numbering the spores or eggs of bacteria, and while confirming M. Pasteur's observation, that they are always present in the air, shows that their number presents incessant variations. Very small in winter, it increases in spring, is very high in summer and autumn, then sinks rapidly when frost sets in. This law also applies to spores of champignons; but while the spores of moulds are abundant in wet periods, the number of aërial bacteria then becomes very small, and it only rises again when drought pervades the soil, a time when the spores of moulds become rare. Thus, to the *maxima* of moulds correspond the *minima* of bacteria, and reciprocally. In summer and autumn, at Montsouris, one finds frequently 1,000 germs of bacteria in a cubic mètre of air. In winter the number not uncommonly descends to four and five, and on some days the dust from 200 litres of air proves incapable of causing infection of the most alterable liquors. In the interior of houses, and in the absence of mechanical movements raising dust from the surface of objects, the air becomes fertilizing only in a volume of 30 to 50 litres. In M. Miquel's laboratory, the dust of five litres usually serves to effect the alteration of neutral bouillon. In the Paris sewers infection of the same liquor is produced by the particles in one litre of air. These results differ considerably, it is pointed out, from those published by Tyndall, who says a few cubic centimètres of air will, in most cases, bring infection into the most diverse infusions. M. Miquel compared the number of deaths from contagious and epidemic diseases in Paris with the number of bacteria in the air during the period from December, 1879, to June, 1880, and certainly, each recrudescence of the aërial bacteria was followed at about eight days' interval by an increase of the deaths in question. Unwilling to say positively that this is more than a mere coincidence, he presents further observations regarding it. M. Miquel further finds (contrary to some authors) that the water-vapor which rises from the ground, from rivers, and from masses in full putrefaction is always micrographically pure; that gases from buried matter in course of decomposition are always exempt from bacteria; and that even impure air sent through putrefied meat, far from being charged with microbes, is entirely purified, provided only the putrid filter be in a state of moisture comparable to that of the earth at 0.30 metres from the surface of the ground.

The International Congress of Anthropology and Prehistoric Archæology holds its next meeting at Lisbon, on September 20-29, this year. Several important questions concerning the prehistoric archæology of Portugal will be discussed. Excursions will be made to several places of archæological interest.

DEYER'S ASTRONOMICAL RECORD.

MR. J. L. E. DEYER, of the Observatory of Trinity College, Dublin, has prepared and published *A Record of the Progress of Astronomy during the year* 1879.

This interesting digest is similar in every way to the summaries given for 1877 and 1878 by Professor Holden, in the *Annual Record of Science and Industry*. It was intended originally to add a bibliographical list of books and memoirs on Astronomy published during the year, but for various reasons this was left out. Such a list ought to embrace a longer space of time than a single year, and besides, the "Bibliographie Générale" the publication of which has recently been announced from the Brussels Observatory, is to include the year 1880. Mr. Deyer's paper therefore calls attention to such publications only as appeared to possess more than a passing interest. These are mentioned under the following heads: Spherical astronomy, theory of instruments, celestial mechanics, the sun, the moon, the inter-mercurial planet question, planets and satellites, comets, meteors and meteorites, fixed stars, nebulæ and clusters, photometry, history of astronomy, bibliography; observatories, miscellaneous notes.

Although the number of working observatories in this country is small, the present summary would indicate that these few had been reasonably active, since nearly one-third of the memoir (fifteen out of forty-seven pages) is devoted to the results of astronomical work done in the United States. O. S.

THE LATE MR. GREENE SMITH.

In regard to our statement in SCIENCE for July 31st, respecting Mr. Greene Smith's offer of his collection of specimens of birds to the American Museum of Natural History, we are reminded by Professor Burt G. Wilder, M. D., that shortly after the opening of Cornell University, in 1868, Mr. Smith presented that institution with a collection of 362 birds, mostly from North America, all perfect specimens and finely mounted.

We have authority for stating, that in regard to the present disposition of the late Mr. Greene Smith's collection, for the present, at least, it will remain in the possession of his widow. Mrs. Greene Smith informs us that she will devote her attention to making the collection as complete as possible, by the addition of the specimens now absent; and at some future time when she considers she has accomplished this task, she will present the collection to some institution, where it will be most appreciated, and do the greatest good.

THE use of steel for marine boilers has of late increased rapidly, but if the latest news from the Clyde is trustworthy, steel boilers have failed under the test, and have been condemned. Some eminent marine engineers refuse to use it, but several new passenger steamers have been fitted with boilers of steel, and a grave responsibility has been incurred by their owners.—*Eng. Mech.*